

Performance of the GRETA prototype detector

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A working, two-dimensionally segmented Ge detector is one of the crucial elements in the development of the concept of γ -ray tracking and its implementation in GRETA [1]. This new technique is based on the ability to measure the three-dimensional positions and energies of individual interactions of γ -rays in the detector. This allows us to determine the scattering sequence and the identification and separation of multiple γ rays by employing tracking algorithms. The three-dimensional position and energy of interactions will be determined by using a two-dimensionally segmented Ge detector along with pulse-shape analysis of the signals. The 36-fold segmented prototype detector which was built by Eurisys Mesures and its segmentation scheme is shown in fig. 1. It consists of a closed-ended HP-Ge n-type crystal with a tapered hexagonal shape [2]. Preamplifiers with

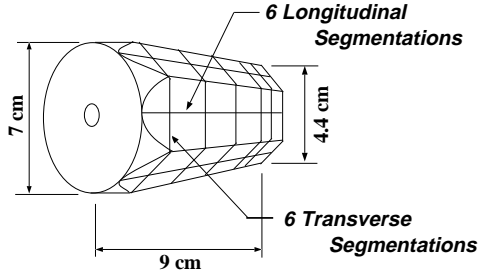


Figure 1: The 36-fold segmented GRETA prototype detector with its tapered and hexagonal shape and the arrangement of its segments.

a compact design, low noise and very good response properties have been built and implemented. An integrated noise level of about 5 keV has been measured for the segment channels. The average energy resolution of this detector was measured to be 1.14 keV and 1.94 keV at 60 keV and 1332 keV, respectively. Segments

signals measured with the detector are shown in fig.2. For comparison, the dashed line indicates calculated signals at the same location. The agreement between measurement and calculation is very good. The spread of signals in this figure is mainly due to the finite opening angle of the collimation system. Using pulse-shape analysis, a three-dimensional position sensitivity of 0.2 mm to 0.5 mm (rms) has been obtained at 374 keV, dependent on the position and the direction. The results represent a major step towards the feasibility of a γ -ray tracking detector.

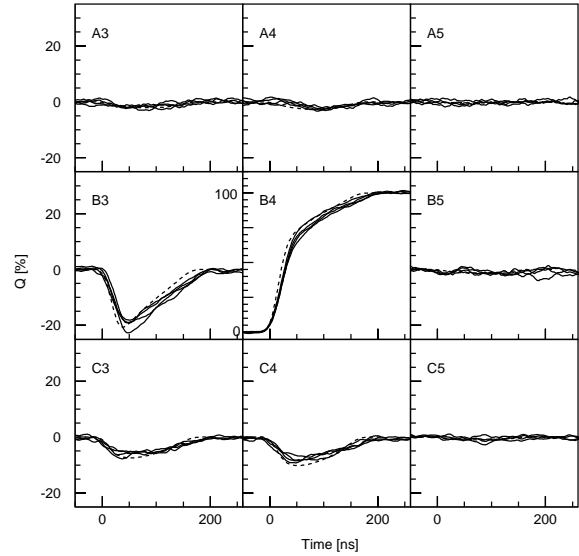


Figure 2: Set of signals measured in the 9 of 36 segments of the GRETA detector. While segment B4 contains the interactions and a net charge signal, the adjacent 8 segments only show a transient charge signal. The letters indicate the azimuthal, the numbers the longitudinal positions of the segment.

References

- [1] M.A. Deleplanque, et al., Nucl. Instr. and Meth. A 430 (1999) 292
- [2] K. Vetter, et al., submitted to Nucl. Instr. and Meth. A